REMARKS

This paper is being provided in response to the Office Action mailed May 24, 2004 for the above-referenced application. In this response, Applicant has amended claims 21, 22, 26-29, 33, 34, and 36-41 to clarify that which Applicant considers to be the invention. Applicant respectfully submits that the amendments to the claims are fully supported by the originally-filed specification. Further, Applicant submits herewith two Declarations under 37 C.F.R. 1.132 by Colin Fox and Charles William Bremner Wood, as discussed below.

The rejection of claims 21, 24-25, 28, 30-33, 35-36, 38, 40 under 35 U.S.C. 103 (a) as being unpatentable over U.S. Patent No. 5,892,833 to Maag (hereinafter "Maag") in view of U.S. Patent No. 4,069,732 to Moskowitz et al. (hereinafter "Moskowitz") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

Independent claim 21, as amended herein, recites a guitar preamplifier. Electronic filters split an input signal into two or more separate frequency bands each having a different center frequency. The filters comprise a substantially equi-phase response whereby any phase shift to substantially any frequency passed in more than one of said frequency bands is substantially the same. Two or more non-linear circuits each distorts one of the frequency bands. A summing network recombines the frequency bands. Claims 22-29 depend directly or indirectly on independent claim 21.

Independent claim 33, as amended herein, recites a digital musical instrument preamplifier. Digital electronic filters split an input sampled signal into two or more separate output frequency bands each having a different center frequency. The filters comprise a substantially equi-phase response whereby any phase shift to substantially any frequency passed in more than one of the frequency bands is substantially the same. Two or more non-linear digital circuits each distort one of the output frequency bands. A digital summing network recombines the frequency bands. Claims 34-39 depend directly or indirectly on independent claim 33.

Independent claim 40, as amended herein, recites a musical instrument preamplifier including electronic filters. The electronic filters include a first filter network which includes an input, a plurality of outputs and a plurality of band splitter filters. The band splitter filters split a signal on the input into a plurality of different, substantially equi-phase frequency bands in which frequency bands of substantially any frequency passed by more than one of the band splitter filters are substantially in phase in all of the bands. A plurality of non-linear circuits are coupled to a plurality of the outputs to distort respective output frequency bands.

The Maag reference discloses a form of equalizer which produces an overall phase response which is asserted to be relatively constant across the audio frequency range. A stated goal of this system is to reduce distortion (see col. 2, lines 42-46 and line 58 of Maag).

The Moskowitz reference discloses an electric guitar which provides signals from each of its electrically conducting strings by the cutting of magnetic field lines. The Office Action cites

Moskowitz as teaching two or more non-linear circuits, each of which distorts one of the frequency bands, and a summing network recombining the frequency bands.

The Office Action states that:

> "Regarding claim 21, Maag teaches that a musical instrument preamplifier a system comprising: a filtering means (see Fig. 6a, 208) for splitting an input signal into two or more separate frequency bands (212a 212n) comprising a substantially equi-phase response for each frequency band;"

Applicant has simulated the analogue embodiment of Fig. 1 of Maag as described in paragraphs 10 to 12 of the previously-filed Declaration by Mark Alistair Poletti, using the R and C values given by Maag. Applicant's simulation shows clearly that the phase responses of each of the six channels of the exemplary embodiment of Maag are not *equi-phase ... whereby any phase shift to substantially any frequency passed in more than one of said frequency bands is substantially the same,* as presently claimed by Applicant. In the exemplary embodiment described by Maag, a frequency of 160 Hz has a phase angle of 45°, 25°, 12°, 7°, -35° and -41° at the output of each of the six band filters, a variation of 86° total across the six bands for this frequency.

Additionally, Applicant submits herewith a Declaration under 37 C.F.R. 1.132 by Colin Fox. Dr. Fox has analyzed the Maag reference and the simulation results included with the previously-submitted Poletti declaration and has reviewed the specification and amended claims of the present application. Dr. Fox concludes that, even assuming the center frequencies of the filters described by Maag are different so as to split the input signal into different frequency

bands, Maag's filters do NOT have an equi-phase response. That is, Dr. Fox concludes that the signal at a given frequency passed by two filters which have appreciable response at that frequency will not be in phase. (See paragraphs 6-8 of the Fox declaration.) Accordingly, in view of the Fox and Poletti declarations, Applicant submits that even if Maag filters are assumed to have different center frequencies (an assumption that is discussed in detail below), Applicant submits that the Maag filters do NOT have an equi-phase response, as claimed by Applicant.

Furthermore, the Office Action states that:

> "Although the resistor values provided exemplary embodiment described at column 4, line 51, column 5, line 14 provide distinct frequency bands, it would have been obvious to one of ordinary skill to make the resistors (R20a-n and R32a-n) the same in each filter so that each filter has an identical response with respect to each other filter, and thus each (identical) frequency band filter would provide a substantially equi-phase response."

In the scenario referred to in the above quoted section of the Office Action where the filters are identical so that each may have the same phase response, the frequency bands of the filters are also identical as the Examiner indicates. Maag makes clear beginning at column 4, line 42 that resistors 24 and 32 determine the center frequencies and high end roll-off or cut-off of the bands. If these have the <u>same value</u> in each filter as postulated by the Examiner, then each filter will also have the <u>same frequency response</u>. This means that they would NOT have different center frequencies.

Accordingly, Claims 21 and 33 have now been amended to refer to "filters for splitting an input signal into two or more separate frequency bands **each having a different center**

frequency". Claim 40 has been amended to refer to "a plurality of band splitter filters to split a signal on the input into a plurality of **different,** substantially equi-phase frequency bands". Claim 41 has been amended to read "filters for splitting an input signal into a plurality of **different,** substantially equi-phase frequency band outputs". Therefore, Applicant's claims as now amended also make explicitly clear that the frequency bands are different.

The Office Action refers to Fig. 6 of Maag, stating:

> "Maag teaches ... a filtering means (see Fig. 6a, 208) for splitting an input signal into two or more separate frequency bands (212a-212n) comprising a substantially equi-phase response for each frequency band; in order to obtain a minimum (or little) phase shift, filters 211a-212n would have substantially the same phase shift. The filters 211a-212n are identical and using the same components. With the circuit configuration described, phase distortion (phase shift) is reduced ..."

Figs 6a to 6c of Maag show a digital implementation of the Maag equalization circuit. The digital filters are implemented using a Motorola DSP 56001 chip, in which the digital filters are implemented in software. While the filters of Fig. 6a to 6c of Maag look the same in the figures in that each one is represented by an element 212a-212n labelled "Digital Filter", they have different band pass functions implemented in software with different parameters in each case. Of course digital filters do not all have the same phase shift just because they are implemented using the same hardware. The different software parameters in each digital filter which produce a different pass band, typically also produce different phase shifts. Applicant's submit that it does not follow that the digital filters of Figs. 6a to 6c of Maag will have the same phase shift in each band.

Also, Applicant has clearly shown via the simulation described in the previously-submitted Poletti declaration (and analyzed in the Fox declaration, noted above) that in the analogue embodiment of Fig. 1 of Maag, while the summed phase response is substantially flat, the individual phase response of each filter in Maag to the same frequency is different. There is nothing to suggest that the phase response of each filter of the digital implementation of Figs 6a to 6c of Maag will be anything different.

Further, claims 21, 33, 40 and 41 have been amended to explicitly require that the filters have *a substantially equi-phase response whereby any phase shift to substantially any frequency passed in more than one of said frequency bands is substantially the same.* Applicant's claimed invention is predicated on the phase shift to frequencies passed in more than one of the bands of Applicant's guitar preamplifier being substantially the same. This provides the benefits referred to paragraphs 6 to 8 of the Poletti declaration. Particularly, when the outputs of all of the bands are recombined, the same frequencies appearing in more than one band are in phase and do not cancel. Put another way, the phase shift experienced by any given frequency passed by more than one of the bands is the same so that the signals at that frequency will combine without cancellation. In accordance with applicant's invention this is particularly advantageous for a guitar preamplifier where non-linear distortion is deliberately introduced into one or more of the bands. Non-linear distortion introduces harmonics at multiples of any frequency f_0 such as $3f_0$ or $5f_0$ which will appear in other bands.

In summary Maag does not disclose that the band filters whether analogue or digital filters have different centre frequencies but the same phase shift (if any) for similar frequencies. To highlight this, it is noted that Maag could be further improved by the addition equi-phase filtering as employed by Applicant, so that distortion in the output of the equaliser of Maag would be further reduced. But the Maag reference does not disclose or suggest this. Maag is deficient as a reference disclosing equi-phase filtering as presently claimed by Applicant.

Concerning the Moskowitz reference, the Office Action states that:

> "... but Maag does not teach clearly two or more non-linear circuits, each of which distorts one of the frequency bands; and a summing network for recombining said frequency bands.
>
> However, Moskowitz teaches two or more non-linear circuits (see Fig. 6, 59), each of which distorts one of the frequency bands; and a summing (87-89) network for recombining said frequency bands (see column 7, lines 3-46).
>
> Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilise the teaching of Moskowitz in to Maag to provide the musician more precise control over the sounds produced by the instrument."

Reconsideration of Moskowitz is respectfully requested. Moskowitz does not use electronic filtering means for separating an input signal into one or more separate frequency bands. There would be no reason to provide the electronic band splitting filtering means of Maag (or of any type) to Moskowitz since Moskowitz already uses a separate magnetic pickup for each string to provide separate frequency bands. It would be completely contrary to the

device of Moskowitz to replace the separate pickup for each string instead with electronic filtering means to split the input signal into bands. An essential feature of the device of Moskowitz is arguably the provision of a separate pickup per string. Applicant submits that there is *no motivation to add* the electronic band splitting filters of Maag to Moskowitz and that, moreover, Moskowitz, as noted above, in fact *teaches away* from this combination, since doing so would require doing away with achieving bands by individual pickups per string which is the central thrust of Moskowitz.

Finally, it is reiterated that Applicant's present claimed invention is the employment of equi-phase band splitting filtering in an electric guitar preamplifier, before then separately applying non-linear distortion to each band and recombining the bands. The equi-phase response enables the desired distorted sounds to be better retained when recombining the bands. The sound quality of a multi-band guitar preamplifier distortion system is further improved. Both the fundamental frequency and all of the non-linearly generated harmonics will have identical phases, and will therefore combine without cancellation occurring. To Applicant's knowledge this has not been achieved previously with any prior electric guitar preamplifier, despite multi-band electric guitar preamplifiers having been proposed some years previously. The distortion products generated in each band add in-phase, preventing cancellation of the desired distortion products. As pointed out previously the output was zero-phase error as shown in Fig. 3 of the application, and demonstrates no cross-like artefacts. The result sounds more even, coherent, and natural to that of the system with non equi-phase filters. Technical benefits of Applicant's invention are outlined in paragraphs 6 to 9 of the Poletti declaration; however, further, Applicant submits herewith a Declaration under 37 C.F.R. 1.132 by Charles William Bremner Wood

concerning the quality of sound produced by an amplifier according to the present claimed invention. Mr. Wood's testing of the amplifier allowed him to conclude that it is one of the most flexible guitar amplifiers that he has used and that it excelled in a wide tonal range without losing quality of sound.

Accordingly, Applicant submits that neither Maag nor Moskowitz, taken alone or in combination, teach or fairly suggest at least the features of an instrument preamplifier including *filters for splitting an input signal into two or more separate frequency bands each having a different center frequency, the filters comprising a substantially equi-phase response whereby any phase shift to substantially any frequency passed in more than one of said frequency bands is substantially the same*, as is claimed by Applicant. In view of the above, Applicant respectfully requests that this rejection be reconsidered and withdrawn.

The rejection of claim 41 under 35 U.S.C. 103(a) and the rejection of claims 22-23, 29, 34 and 39 all as being unpatentable over Maag in view of Moskowitz and further in view of U.S. Patent No. 4,412,100 to Orban (hereinafter "Orban") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

Independent claim 41, as amended herein, recites a musical instrument preamplifier system. Electronic filters split an input signal into a plurality of different, substantially equi-phase frequency band outputs in which frequency bands of substantially any frequency passed by a plurality of band splitter filters are substantially in phase in all of said bands. A plurality of non-linear circuits are coupled to the filters to distort respective output frequency bands. The

filters include a cascade of a first filter network and one or more subsequent filter networks. Each network includes an input, a plurality of outputs and the plurality of band splitter filters that split a signal on the input into a plurality of different frequency bands for the outputs. For one ore more of the subsequent networks, the input of each is coupled to one output of another network via a filter to provide substantially equi-phase frequency bands on the network's outputs. Outputs of some of the networks form frequency band outputs of the filters.

The Maag and Moskowitz references are discussed above.

The Orban reference discloses a multiband analog audio process which provides low peak-to-r.m.s ratios of audio signals. A distributed crossover system is used with bandpass filters containing internal clippers.

Applicant respectfully submits that Orban does not overcome the above-noted deficiencies of the Maag and Moskowitz references with respect to the present claimed invention. Applicant respectfully submits that neither Orban, Maag nor Moskowitz, taken alone or in any combination, teach or fairly suggest at least the above-noted features as claimed by Applicant. Accordingly, Applicant respectfully requests that these rejections be reconsidered and withdrawn.

The rejection of claims 26-27 and 37 under 35 U.S.C. 103(a) as being unpatentable over Maag in view of Moskowitz and further in view of JP404142598 to Koichiro (hereinafter

"Koichiro") is hereby traversed and reconsideration is respectfully requested, in view of the amendments to the claims contained herein.

Applicant's independent claims 21 and 33 are discussed above. Claims 26-27 and 37 depend therefrom.

The Maag and Moskowitz references are discussed above.

The Koichiro reference discloses an electronic musical instrument having a musical signal generating circuit to generate digital musical sound signals. The Office Action cites Koichiro as disclosing filtering means further comprising variable cross-mixing after one or more of said stages of filtering.

Applicant respectfully submits that Koichiro does not overcome the above-noted deficiencies of the Maag and Moskowitz references with respect to the present claimed invention. Applicant respectfully submits that neither Koichiro, Maag nor Moskowitz, taken alone or in any combination, teach or fairly suggest at least the above-noted features as claimed by Applicant. Accordingly, Applicant respectfully requests that these rejections be reconsidered and withdrawn.

The rejection of claims 28 and 38 under 35 U.S.C. 103(a) as being unpatentable over Maag in view of Moskowitz and Koichiro and further in view of U.S. Patent No. 5,841,875 to

Kuroki (hereinafter "Kuroki") is hereby traversed and reconsideration is respectfully requested in view of the amendments to the claims contained herein.

The features of independent claims 21 and 33 are discussed above. Claims 28 and 38 depend therefrom.

The Maag, Moskowitz and Koichiro references are discussed above.

The Kuroki reference discloses a digital audio signal processor with harmonics modification. The Office Action cites Kuroki as disclosing a preamplifier of low pass filtering means after non-linear circuits to reduce high frequency distortion products.

Applicant respectfully submits that Kuroki does not overcome the above-noted deficiencies of the Maag, Moskowitz and Koichiro references with respect to the present claimed invention. Applicant respectfully submits that neither Kuroki, Koichiro, Maag nor Moskowitz, taken alone or in any combination, teach or fairly suggest at least the above-noted features as claimed by Applicant. Accordingly, Applicant respectfully requests that these rejections be reconsidered and withdrawn.

Based on the above, Applicant respectfully requests that the Examiner reconsider and withdraw all outstanding rejections and objections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the Examiner is invited to contact the undersigned at 617-248-4792.

Respectfully submitted,
CHOATE, HALL & STEWART

Date: November 22, 2004

Elijah E. Cocks
Registration No. 47,499

Choate, Hall & Stewart
Exchange Place
53 State Street
Boston, MA 02109
Fax: (617) 248-4000